



# امتحانى اداره كيفيت وچگونگى

***Quality Control Testing***



- **Laboratory must be certified for use by the AED**
- لابراتوار مورد استفاده باید توسط موسسه انجینیری ساحه افغانستان تصدیق شده باشد
  - POC : Rudie, Keith, [Keith.A.Rudie@usace.army.mil](mailto:Keith.A.Rudie@usace.army.mil)
  - رودی کیت: شخص تماس
- **Certification involves ensuring:**
- برای تصدیق شدن موضوعات ذیل را دربردارد
  - Knowledge فهم
  - Facilities امکانات
  - Equipment وسایل
  - Test procedures روش امتحانی و تحلیلی مواد
  - Test reports راپور امتحانی و تحلیلی مواد



# Referenced Test Procedures

روش های امتحان و تحلیل مواد ارجاعی



- AED-specified test procedures:
- روش های امتحان و تحلیل مواد مشخصه موسسه انجیری ساحه افغانستان
  - ASTM (American Society for testing of Materials )
  - a few CRD-C (Test Method for Consistency of No-Slump Concrete)
  - a few AASHTO (American Association of State Highway and Transportation Officials)
- Only 2 British Standards allowed



# Other Necessary Laboratory Policies



- ASTM standards must be available in lab
- Calibrations and verifications every 12 mo.
  - Compression testing machines
  - Scales and balances

# Other Necessary Laboratory Policies



- Need a mercury thermometer to check ovens with digital readouts
- Knowledge about Unified Soil Classification System
  - GW, GP, GM, SW, SP, SM, SC, CL, ML, CH, MH
  - Many labs know only AASHTO soil classification

# Sufficient Precision of Scales



Precision  
(grams)

5	Sand cone
1	Modified Proctor
0.5	Coarse aggregate (sieve & SG)
0.1	Fine aggregate (sieve & SG)
0.01	Soil (sieve & Atterberg limits)

Example

# Company Performing Tests



- Prefer companies subcontract the QC testing
- If using your own lab, have another lab identified for use on request by AED
  - Companion cylinders
  - Companion soil densities, lab Proctors, etc.
- AED has begun QA testing



# Frequency of Testing



- Read specification carefully
- Discuss in the Preparatory Meeting
- May need to know 'lot' size





# Frequency of Testing



- Soil/Aggregate testing by:
  - o Cubic meters, square meters, or linear meters (each lift)
- Concrete testing by:
  - o Cubic meters, number of trucks, or #/day
- Asphalt testing by:
  - o Metric tons, cubic meters, square meters, liters, #/day
- CMU/mortar testing by:
  - o Number of blocks used, #/day

# Guide Specifications



## SECTION TABLE OF CONTENTS

### DIVISION 32 - EXTERIOR IMPROVEMENTS

#### SECTION 32 11 23

#### AGGREGATE AND/OR GRADED-CRUSHED AGGREGATE BASE COURSE

04/06

Submittal Requirements

Sampling and Testing Procedures

Testing Frequency

Material Requirements

Construction Requirements

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- 3.6 TRAFFIC
- 3.7 MAINTENANCE
- 3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

# Common QC Test Problems



- Soil
- Aggregate
- Concrete
- Masonry
- Asphalt
- Steel

# Soil Backfill



- Maximum size = 75 mm
- Required data:
  - Gradation
  - Plasticity
  - Unified soil classification (ASTM D 2487)



# Sieves



- Need to be ASTM E 11
  - Required by ASTM C 136 and D 422



# Sieves



- Sieves need to be ASTM E 11
  - Required by ASTM C 136 and D 422



*ASTM E 11*



# Flat and Elongated Particles



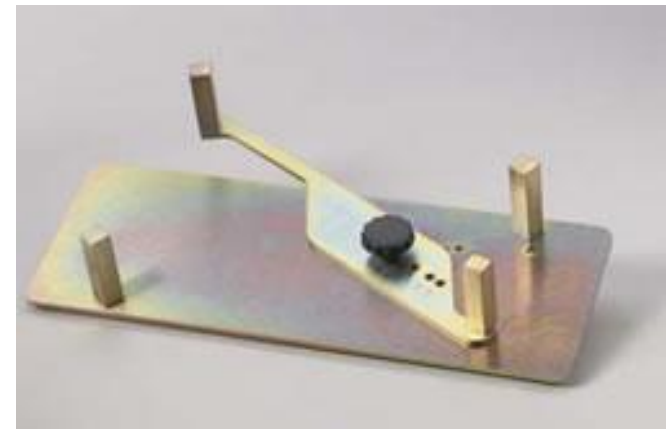
- AED specs use ASTM D 4791
- British Standards, BS 812, are acceptable



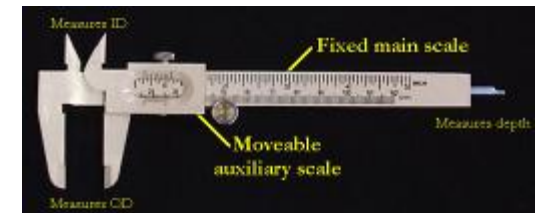
Flakiness index  
Section 105.1



Elongation index  
Section 105.1



or



# Nuclear Density Gauge



- Nuclear gage must be verified against sand cone for each soil
  - Moisture content and density



*Nuclear Gauge  
(ASTM D 2922)*



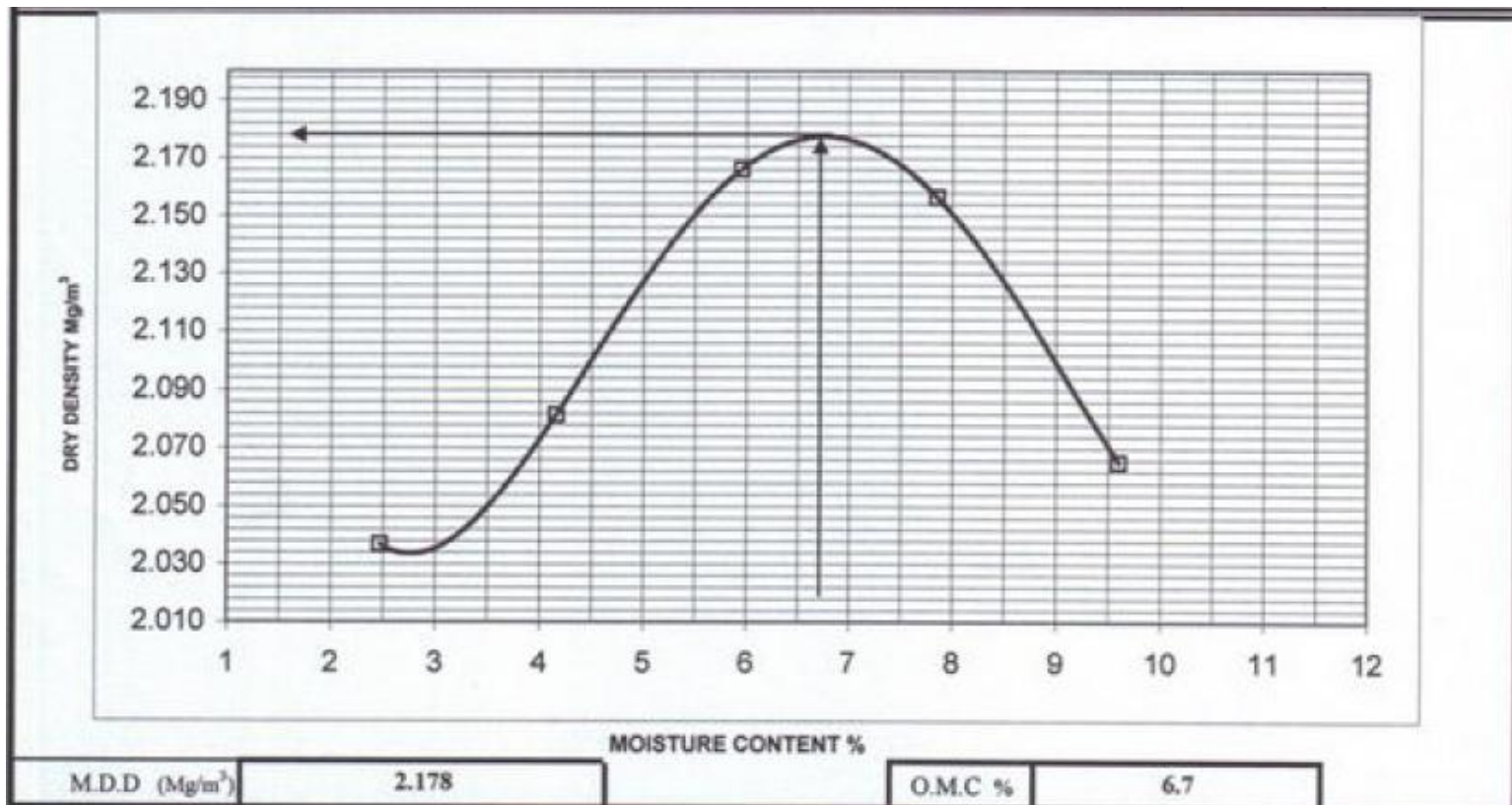
*Sand Cone  
(ASTM D 1556)*



# Moisture Density Curve



- State that the test is ASTM D 1557
  - All specs are based on "Modified Proctor"



# California Bearing Ratio



- Pavement subgrade - need soaked California bearing ratio (ASTM D 1883)
- Soak for 96 hours



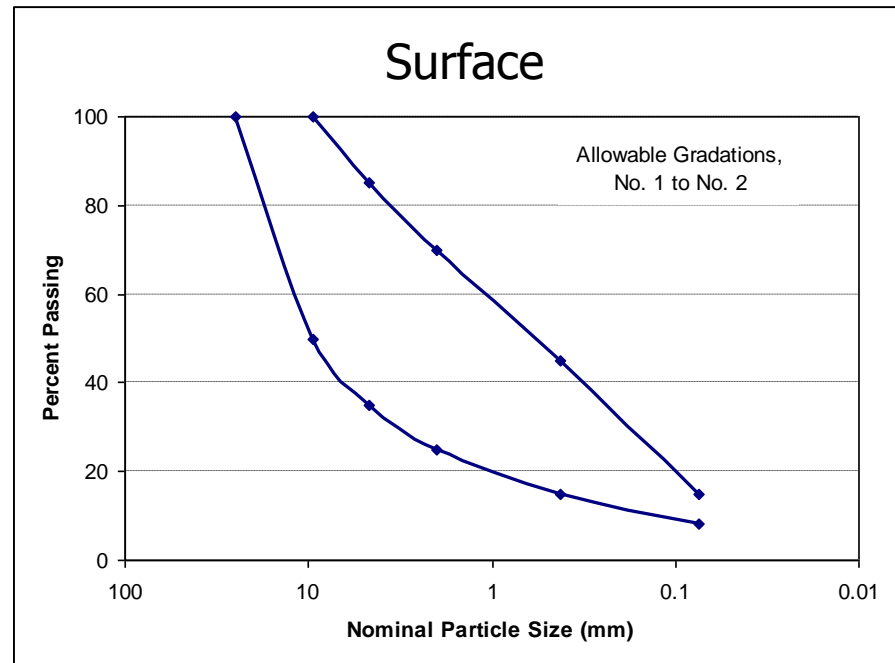
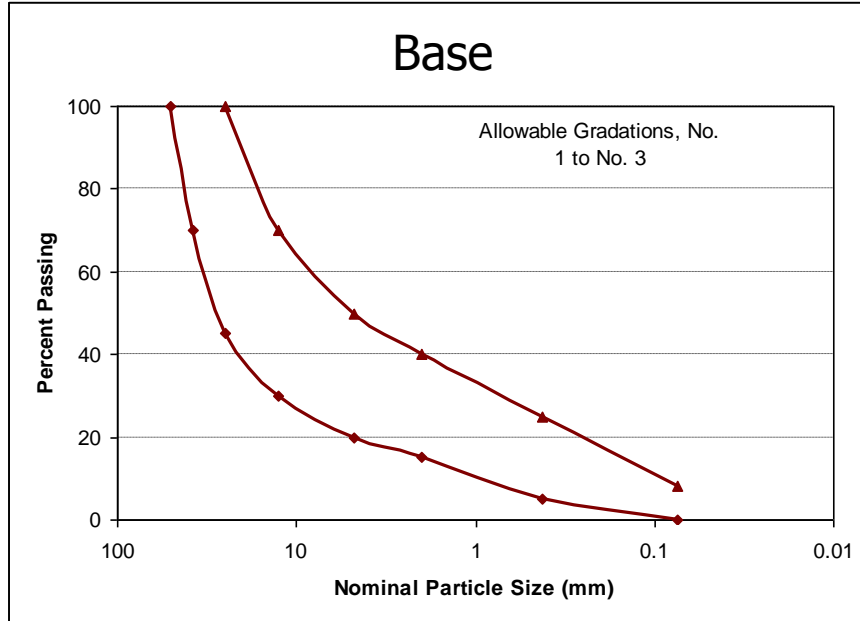
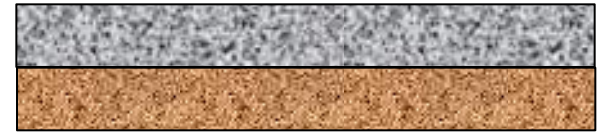
# Aggregates



- Base Course  $\neq$  Aggregate Surface Course



Surface Aggregate



# Aggregates



- Don't forget ...
  - o If it is supposed to be crushed, we need verification
    - ~ ASTM D 5821
  - o If it has a defined thickness, we need verification
    - ~ Typically, at the same frequency as density tests

# Concrete Mixture Design



- Mixture target ( $f'_{cr}$ ) > design strength ( $f'_c$ )
  - Difference  $\sim$  7 MPa (1000 psi)
- Look for air content requirements in specification
- Check durability requirements in ACI 318
- Lab must know ACI 211 and ASTM C 33

# Concrete Mixture Design



- ACI 211 mix design:
  - Mixture proportions
  - Aggregate properties
  - Admixture data sheets
  - Cement test results (ASTM C 150)
  - Trial mix with measured slump, air content, and 28-day strength

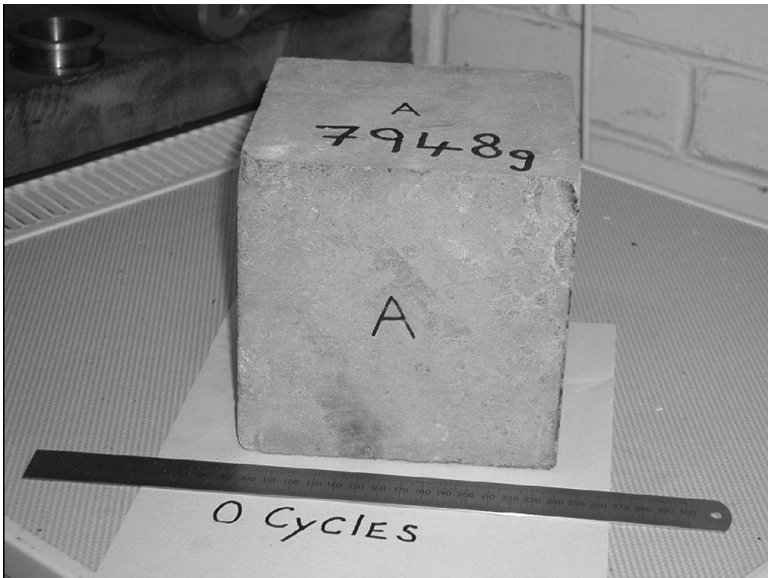




# Concrete Cylinders



*ASTM C 39*



150 mm cube

≠



150 mm x 300 mm cylinder

# Concrete Cylinders – Initial Curing



## *ASTM C 31*

- Up to 48 hrs
- No movement
- Level surface
- 16 to 27 °C
- No moisture loss
- Gentle transition to final curing



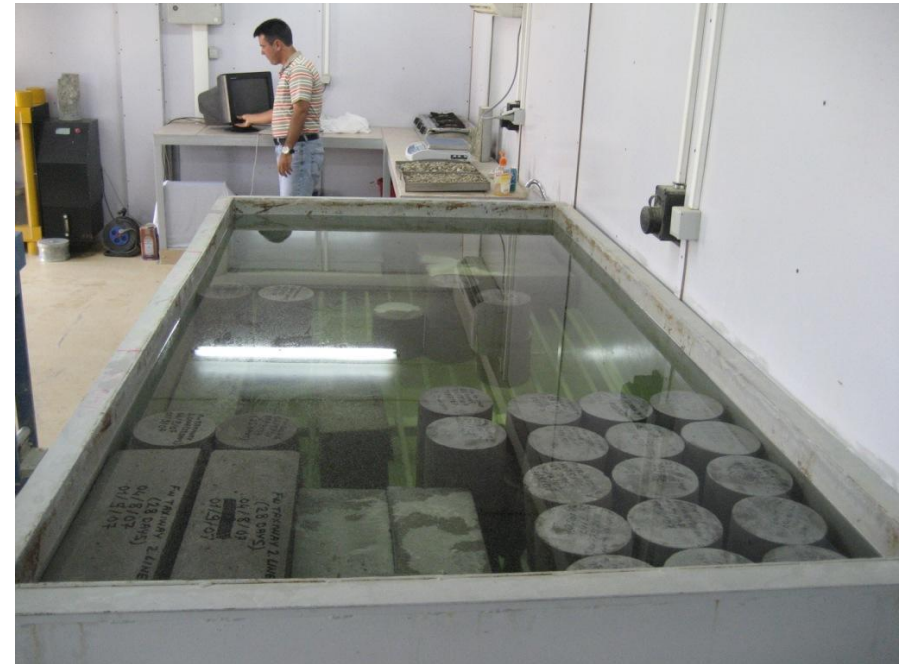


# Concrete Cylinders – Final Curing



*ASTM C 511*

- Keep surfaces wet
- 21 to 25 °C
- Fog room or
- Water storage tank
  - Saturated with lime



# Capping Cylinders



*ASTM C 617*

- Cap both ends
- Remove water from the concrete surface
- Vertical alignment

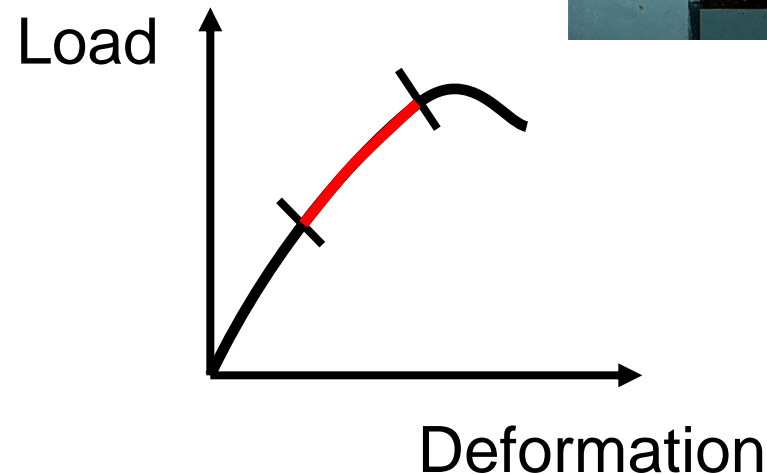


# Compression Testing



*ASTM C 39*

- Keep concrete moist
- Top bearing block can rotate
- Loading rate = 0.15 to 0.35 MPa/s

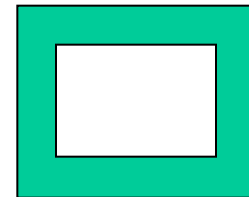


# Concrete Masonry Units (CMUs)



*ASTM C 140*

- Compressive Strength Testing
  - Test a full block or a fully enclosed cell without projections



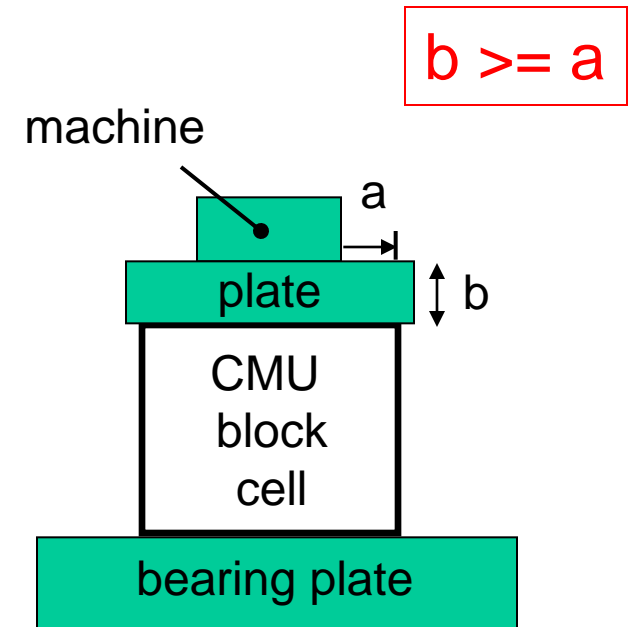
top view of  
a single cell



# Concrete Masonry Units (CMUs)



- Compressive Strength Testing
  - Capped
  - Bearing plate



ASTM C 140

# Asphalt Mixture Design



- “Job mix formula”
  - 75-blow, not 50-blow
  - Aggregate information
  - Binder (AC) properties
    - ~ Penetration Grade 60-70 (ASTM D 946)
  - AC source
  - Optimum percent AC
  - Mix properties
    - ~ Next page

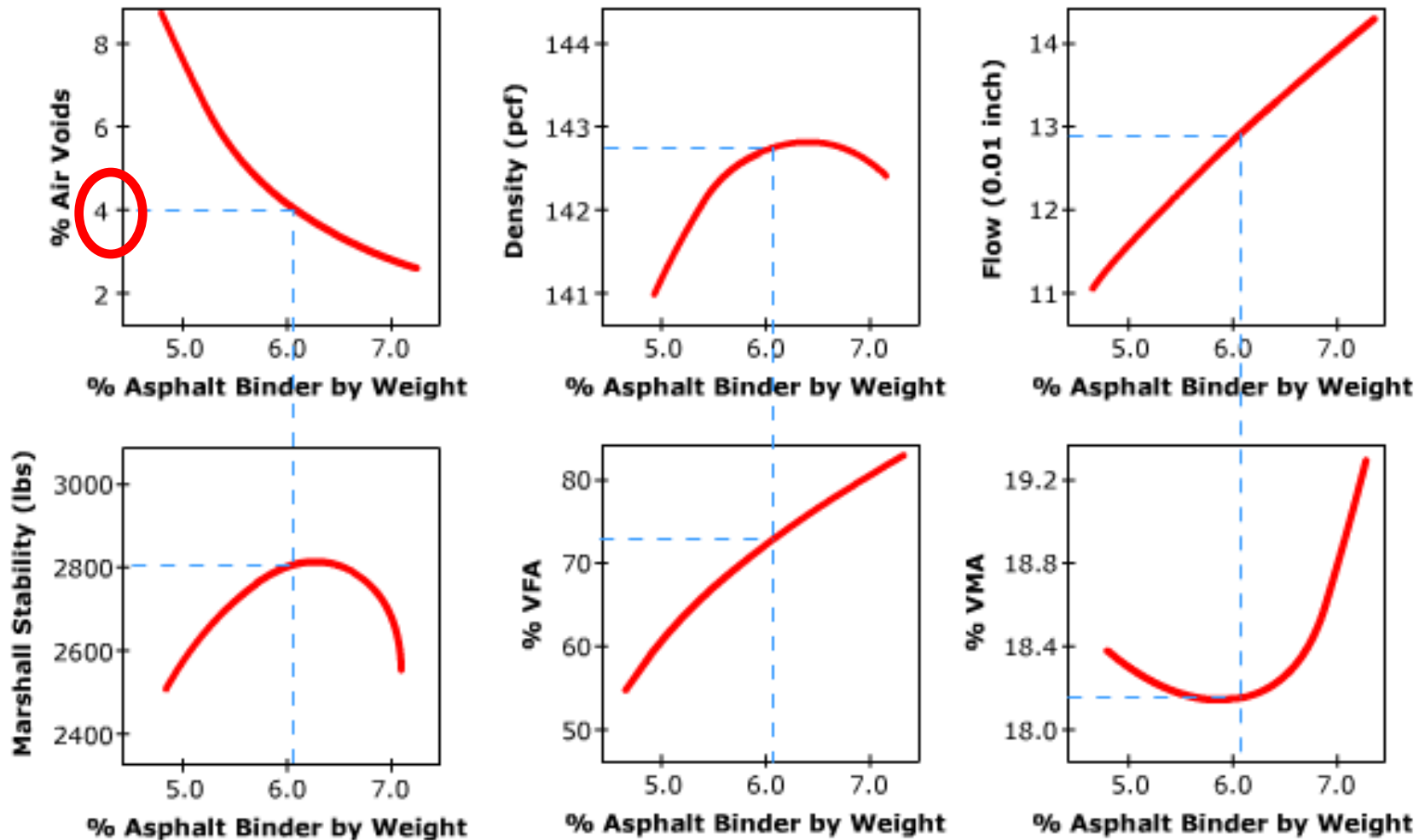
Marshall Method,  
Asphalt Institute MS-2



# Asphalt Mixture Design



75-blow



# Reinforcing Steel



- Deformed bars
  - Generally, Grade 60
  - ASTM A 615
- Requirements:
  - Deformation geometry
  - Ultimate and yield strengths
  - Percent elongation and bend test





# QC Test Reporting



- Tell the labs that you expect all the information listed in the “Report” section of the ASTM procedures



# Modified Proctor Test



*ASTM D 1557*

## 12. Report: Data Sheet(s)/Form(s)

12.1 The methodology used to specify how data are recorded on the test data sheet(s)/form(s), as described below, is covered in Section 1.6.

12.2 The data sheet(s)/form(s) shall contain as a minimum the following information:

12.2.1 Method used (A, B, or C).

12.2.2 Preparation method used (moist or dry).

12.2.3 As-received water content, if determined, nearest 1 %.

12.2.4 Modified optimum water content,  $\text{Mod-}w_{\text{opt}}$  to nearest 0.1 %.

12.2.5 Modified maximum (optimum) dry unit weight,  $\text{Mod-}\gamma_{\text{d,max}}$  nearest 0.1 lbf/ft<sup>3</sup> or 0.02 kN/m<sup>3</sup>.

12.2.6 Type of rammer (manual or mechanical).

12.2.7 Soil sieve data when applicable for selection of Method (A, B, or C) used.

12.2.8 Description of sample used in test (as a minimum, color and group name and symbol), by Practice D 2488, or classification by Test Method D 2487.

12.2.9 Specific gravity and method of determination, nearest 0.01 value.

12.2.10 Identification of sample used in test, for example, project number/name, location, depth, and the like.

12.2.11 Compaction curve plot showing compaction points used to establish compaction curve, and 100 % saturation curve, value or point of maximum dry unit weight and optimum water content.

12.2.12 Percentages for the fractions retained ( $P_C$ ) and passing ( $P_F$ ) the sieve used in Method A, B, or C, nearest 1 %. In addition, if compaction data ( $\text{Mod-}w_{\text{opt}}$  and  $\text{Mod-}\gamma_{\text{d,max}}$ ) are corrected for the oversize fraction, include that data.

# Discussion



Rebound ("Schmidt") Hammer

ASTM C 805, "Rebound Number of Hardened Concrete"